Space Weather Technical Forecast

Issued on Thursday, 31 August 2023 at 01:15 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Slight chance of isolated M-class flares (R1-R2 Blackouts). Slight chance of coronal hole high speed stream arriving on Day 2.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Low, with only minor C-class flares in the past 24 hours. There are currently seven sunspot regions on the visible disc. Two of these, namely AR3413 and AR3415, are relatively large and complex but have been mostly inactive, although AR3413 was the source of the largest flare today, reaching C3.0 at 30/2327 UTC. AR3417 in the southeast is showing signs that the leading spot may be splitting, but has been otherwise mostly unchanged. The other regions are small and simple.
A filament lift-off was observed near centre-disc at around 30/2100 UTC on SDO/AIA imagery, along with a long period C-class flare. An associated EUV wave was also evident in dimming imagery. This event may produce an Earth-directed CME given its location, although awaiting coronagraph imagery for further analysis. No other Earth-directed CMEs were observed leaving the sun on available imagery over the last 24 hours.

Solar Wind / Geomagnetic Activity: Solar wind parameters, as observed by ACE/DSCOVR at L1, were typical of a slow regime. The solar wind was slow-ambient, between 290-350km/s, along with a below average density. The interplanetary magnetic field, Bt, was weak and below 7nT, while its north-south component (Bz) fluctuated erratically between +/-6nT. The Phi angle was predominantly negative (towards the Sun) but shifted positive (away from the sun) at times, possibly indicating a weak connection with the HSS originating from CH38/- (no longer on disc). The results of these aforementioned parameters was a Quiet (Kp 0-2) geomagnetic activity.

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux remained at background levels. GOES16 high energy (greater than 2MeV) electron flux was mostly at background, only briefly reaching moderate levels with a maximum of 123 pfu at 30/1705 UTC. The associated 24-hour fluence was well below the Active threshold and on a downward trend, with 1.46e6 integrated pfu observed at 31/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: The current Low solar activity is expected to continue with a chance of an isolated M-class flare. The most likely source for this activity may be from AR3417 located in the southeast that produced the last moderate flare.

Solar Wind / Geomagnetic Activity: There are no other Earth-directed CMEs currently forecast, although a filament eruption from near centre disc may produce a CME, which could potentially be Earth-directed given its location, though currently awaiting the relevant coronagraph imagery for analysis of this event. Solar winds are at slow-ambient levels and will probably remain unchanged - pending any analysis of the filament eruption and potential CME mentioned above. The next impact on the solar winds looks to be from a coronal hole (CH40/+)

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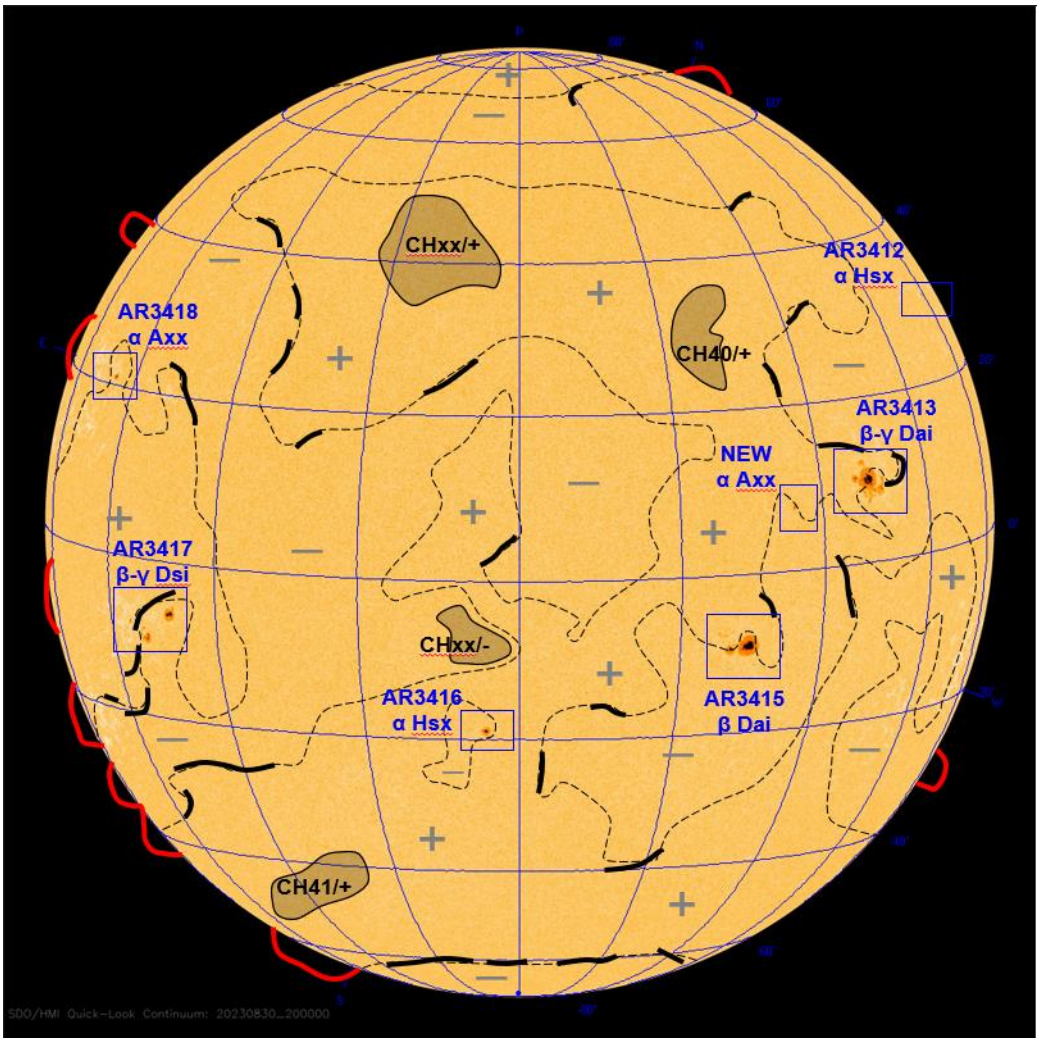
which may give an enhancement to slightly elevated levels for a time into Day 2 (01 Sep), before easing on Day 3 (02 Sep) down to background levels, with any further enhancement beyond this subject to the CME analysis mentioned above. Geomagnetic activity is likely to remain Quiet (Kp 0-2) on Day 1 (31 Aug) before potential coronal hole influence may increase activity on Day 2 (01 Sep), with activity then likely easing back to background levels from Day 3 (02 Sep).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is expected to remain at background levels, with just a slight chance of enhancement, mainly should any larger flares occur from AR3413 or AR3415. High energy (greater than 2 MeV) electron flux is expected to persist at background to moderate levels, but may see some response in association with the possible glancing CME. The associated 24 hour fluence is expected to remain below the Active level (1e8 integrated pfu) on a probable flat trend, and may even drift lower in coming days.

Figure 1. Solar Analysis Valid 30/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are currently no Earth-directed CMEs in the forecast. However, a filament eruption near centre-disc appears to have produced a halo CME, which is beginning to emerge in LASCO-c2 coronagraph imagery. Given the location of the filament eruption, this is likely to have an Earth-directed component, although currently awaiting further coronagraph imagery for a detailed analysis.

The solar wind is currently at slow-ambient levels around 310km/s. There is a possible high speed stream en-route to Earth as a result of coronal hole CH40/+ moving into a more geo-effective position, albeit positioned to the North. Any enhancement is likely to be modest and perhaps lead to a few Unsettled or Active geomagnetic intervals. The Met Office Enlil indicates solar winds reaching slightly elevated levels, 450-500km/s, into Day 2 (01 Sep) but this is considered slightly overdone. If the high speed stream does arrive, then winds will ease back down to background levels into Day 3 (02 Sep), with any further enhancement beyond that subject to the possible CME mentioned above - pending analysis.
All things considered geomagnetic activity is most likely to remain Quiet, before potential coronal hole influence likely increases activity on Day 2 (01 Sep) and into Day 3 (02 Sep), before easing back to background levels.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	10	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: Solar Demon dimming detection shows EUV wave near centre disc

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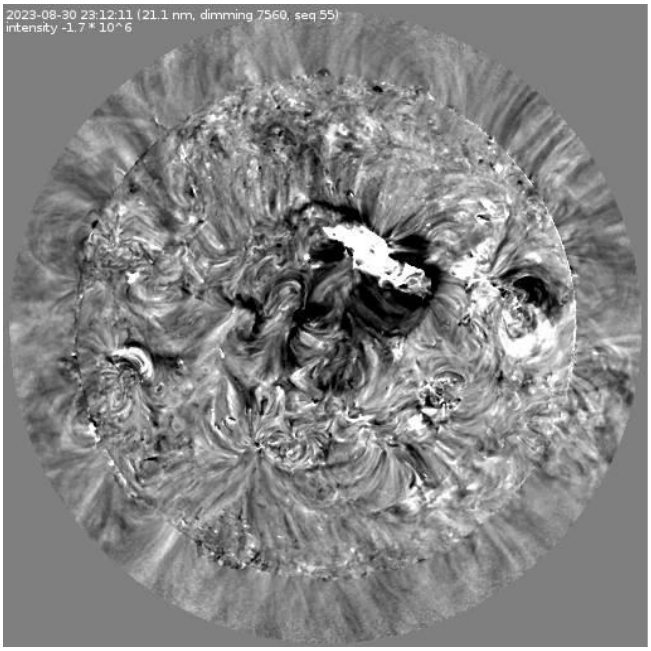
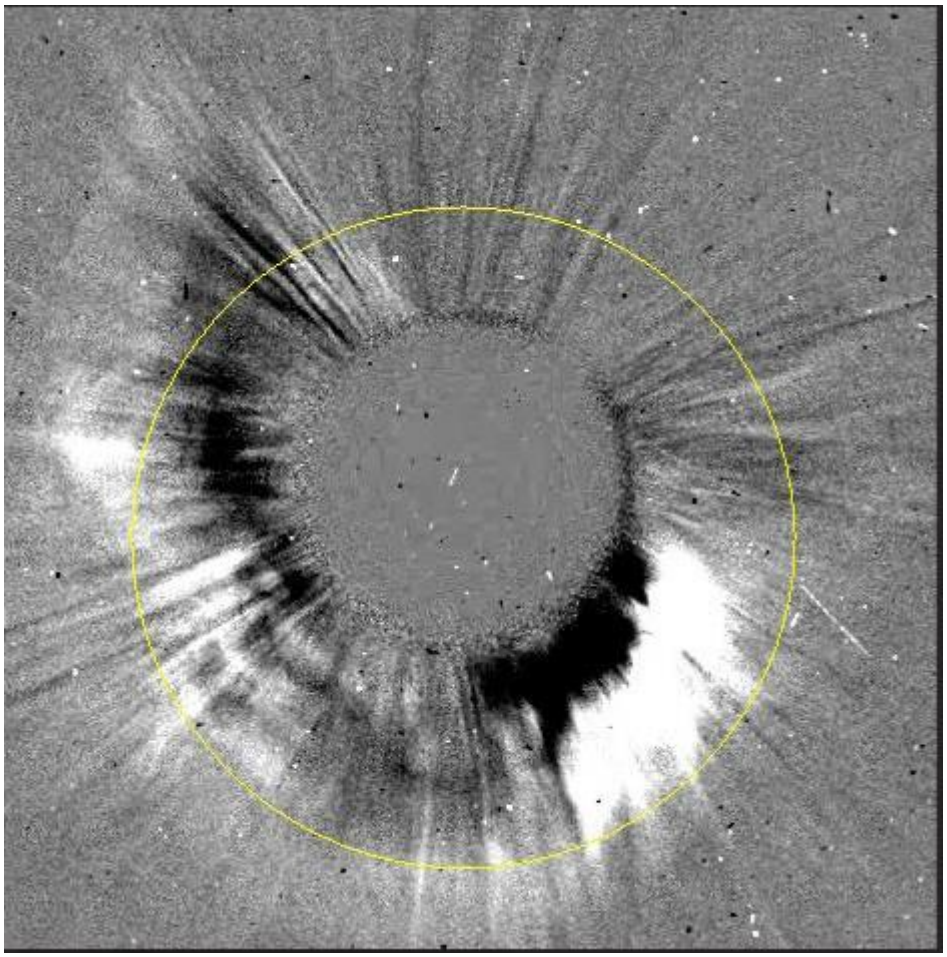


Figure 3: LASCO C2 imagery showing emerging full halo CME following filament eruption near centre disc – analysis pending.



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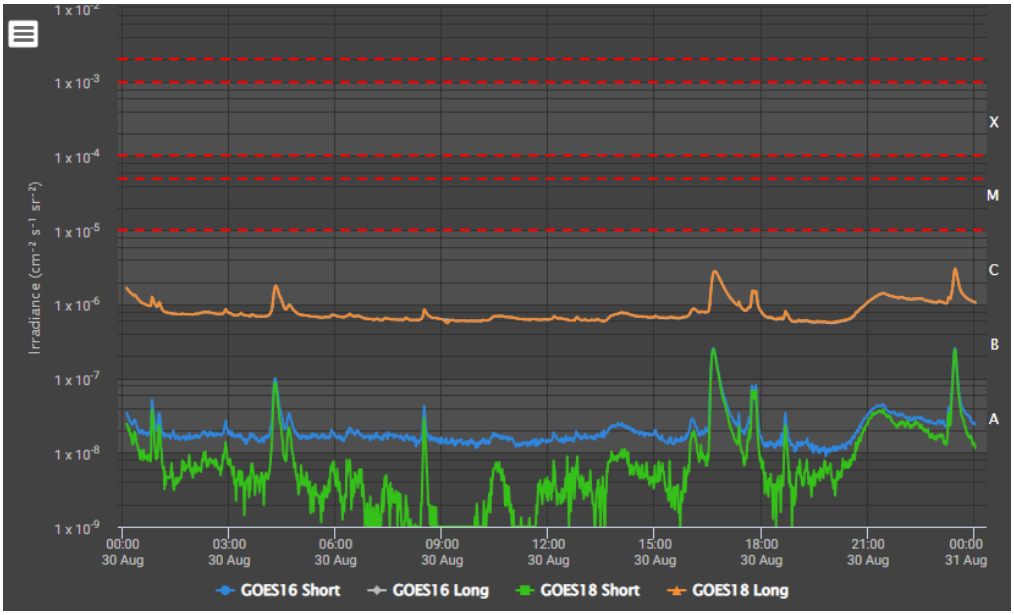
Radio Blackouts - X-Ray Flares:
There are currently seven sunspot regions on the visible disc. Of the three main sunspot groups, two are relatively large and complex but largely inactive, namely AR3413 and AR3415. AR3413, in the northwest, has remained roughly the same. It has seen the larger penumbra on its trailing edge continue to fade, as well as a few smaller spots, but there has been some growth in other small spots. AR3415, in the southwest, has reduced in overall size with peripheral spots fading. AR3417, in the southeast, remains largely unchanged. It consists of a leading spot with penumbra and several spots with rudimentary penumbrae, followed by a large plage. The leading spot is showing hints that it may be splitting, but on the whole the region has remained fairly stable. The newly numbered region in the northeast, AR3418, has simplified for the time being into one spot, but further complexity may reveal itself as it rotates onto the disc, with a large area of plage trailing the leading spot.

The current low solar activity is expected to continue during the forecast period, with only a slight chance of an isolated M-class flares, either from AR3413/AR3415 or perhaps more probably from AR3417 in the southeast given previous history of recent M-class flare activity.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	20	20	20	20
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 4: GOES X-rays



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Solar Radiation Storms - (High Energy Protons):

High energy (greater than 10MeV) proton flux observed by GOES16 is expected to remain at background levels with just a slight chance of enhancement. The main risk of any increased proton flux would be from the occurrence of any larger flares from AR3415 or AR3413.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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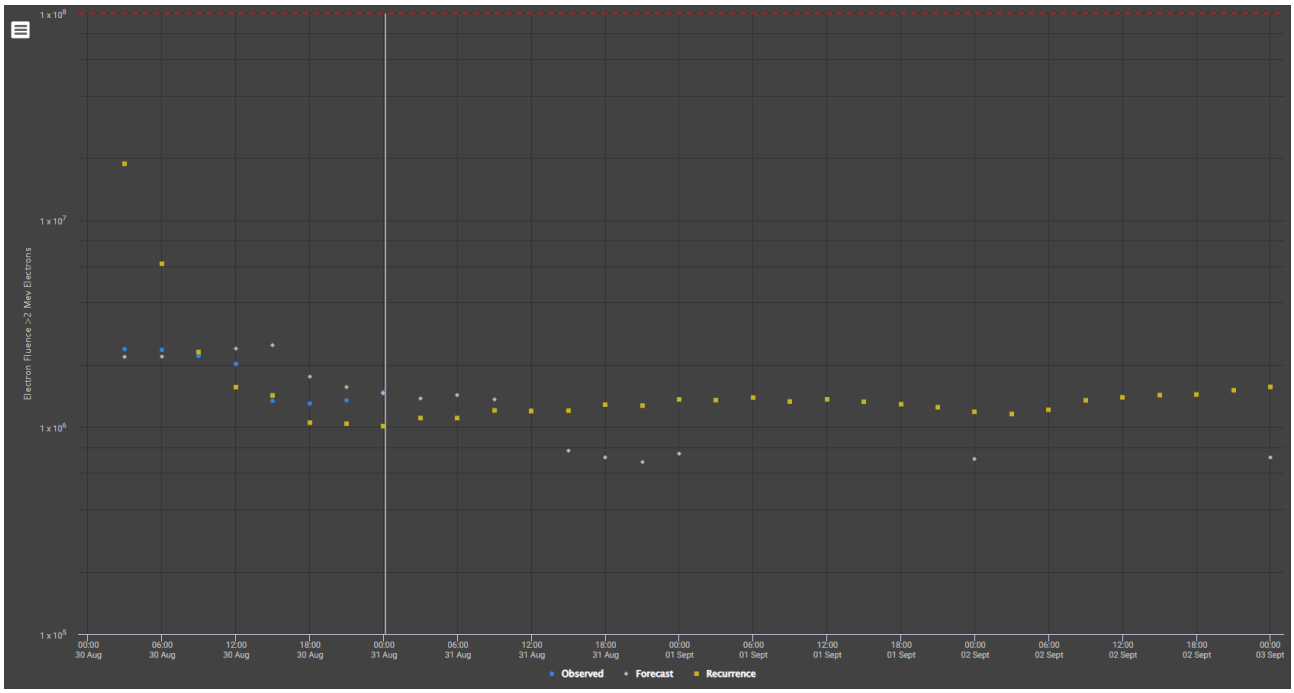
High Energy Electrons Event (≥ 2MeV):

High energy (greater than 2 MeV) electron flux observed by GOES16 is expected to remain at background to moderate levels for much of the period, given a lack of recent electron enhancement. A coronal hole (CH40/+) may see an enhancement of solar winds from Day 2 (01 Sep) which may see some electron flux response, but confidence is low due to the northern positioning of the coronal hole as to how much of an effect it will have.

The associated 24 hour fluence is expected to remain below the Active (1e8 integrated pfu) level, with any rise in fluence likely to be modest. This is supported by the Met Office REFM output, which currently appears to offer sensible advice.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	5	5	5	5
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 5: REFM electron fluence observations, forecast and recurrance.



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